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Impact of Post Panicle Initiation Nutrient Management on the Yield of Rice (*var.* ADT – 36)

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Abstract: Field experiments were conducted at Tamil Nadu Agricultural University, Coimbatore, India during r*abi* (November 2000 – March 2001) and *Kharif* (July 2001 – November 2001) seasons to identify the effect of post panicle initiation nutrient management on the yield components and yield of Rice (Var ADT – 36). Furnace slag was applied as a silicon source at 2 t ha^{-1} at the panicle initiation stage along with other nutrients, *viz.,* nitrogen, phosphorus and potassium which were applied in splits at different crop stages. Among the nutrients, nitrogen was applied at two levels (150 Kg N ha^{-1} and 120 kg N ha^{-1}) in four treatments. From the results of the two season experiments, it is concluded that the yield components *viz*., number of productive tillers per m^2, panicle per unit area, filled grains per panicle and test weight were higher with application of N and K at flowering with slag at panicle initiation stage than all the other nutrient managements. The same treatment also has recorded the highest grain yield of 4889 kg ha^{-1} during *rabi* and 5760 kg ha^{-1}during *kharif* seasons, respectively. The post panicle initiation nutrient management did not influence much the harvest index of the crop.

Key words: Rice, post panicle initiation, nutrient management, furnace slag, yield

INTRODUCTION

In India, rice crop accounts for about 22 per cent of the total cropped area, 31 per cent of the total area under food grains and 39 per cent of the total area under cereals. Rice accounts 41 per cent of the total grain out put and 46 per cent of the total cereals production. Rice is grown over an area of about 42 m ha with 4.5 per cent under irrigation. It was opined that in India, 45 per cent of lower yield obtained with modern technology, over traditional methods, could be attributed to a single factor *viz.,* fertilizer material used or applied at a wrong time or in appropriate application method adopted[7]. To meet this challenge of increased food demand, the productivity per unit area per unit time has to be necessarily increased while all other approaches are obviously static. Enhancing productivity from the existing rice areas of India has to be achieved by narrowing the existing gap between the realized and potential. This is possible to certain extent with the efficient management of nutrients in the rice soils. Since, rice crop requires large quantities of nutrients; a sustained supply is necessary up to heading when the reproductive stage is complete. Hence, the post panicle nutrient management may aid in sustaining the productivity and maintaining soil fertility at fairly high level. With this background idea, a research work was carried out to find out the best post panicle initiation nutrient management in rice.

MATERIAL AND METHODS

Field experiments were conducted at Tamil Nadu Agricultural University, Coimbatore, India during *rabi* 2000-01 (November 2000 – March 2001) and *Kharif* 2001 (July 2001 – November 2001). The soil of the experimental site was clay loam, medium in organic carbon (0.63), medium in available N (254, 267 kg ha^{-1}), medium in available P (15.8, 14.9 kg ha^{-1}) and high in available K (511, 503 kg ha^{-1}) with pH 7.72 and 7.65. The electrical conductivity was 0.40 dS m^{-1}.

The experiments were laid out in a randomized block design with three replications during both the seasons in a puddled lowland rice ecosystem. There were eight treatments in total. Nitrogen was applied at two levels (150 kg N ha^{-1} and 120 kg N ha^{-1}) in four treatments each and P and K were applied at 50 kg ha^{-1} each but at different stages in split doses (Table 1). The furnace slag obtained as waste from iron industry was applied as silicon source @ 2 t ha^{-1}. In all the treatments the nutrients were applied in splits at different crop stages [Basal, Active Tillering (AT), Panicle Initiation (PI) and Flowering stages]. The recommended dose with split application of fertilizer

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Table 1: Treatment Details

Treatment	Basal	AT	PI	FL
T_1	$N_{60}P_{25}K_{25}$	N_{20}	$N_{40}P_{25}K_{25}$	-
T_2	$N_{60}P_{25}K_{25}$	N_{20}	$N_{40}P_{25}K_{25}$	N_{40}
T_3	$N_{60}P_{25}K_{25}$	N_{20}	$N_{40}P_{25}$	K_{25}
T_4	$N_{60}P_{25}K_{25}$	N_{20}	$N_{40}P_{25}K_{25}$ Si $_{2\ t}$	-
T_5	$N_{60}P_{25}K_{25}$	N_{20}	$N_{40}K_{25}$	P_{25}
T_6	$N_{60}P_{25}K_{25}$	N_{20}	$N_{40}P_{25}$	$N_{40}K_{25}$
T_7	$N_{60}P_{25}K_{25}$	N_{20}	$N_{40}P_{25}$ Si $_{2\ t}$	$N_{40}K_{25}$
T_8	$N_{60}P_{25}K_{25}$	N_{20}	N_{40} Si $_{2\ t}$	$N_{40}P_{25}K_{25}$

Si = 2 t ha^{-1} furnace slag, AT = Active Tillering stage, PI = Panicle Initiation Stage, FL = Flowering stage

was taken as the control plot (T_1). The cultivar Aduthurai 36 (ADT-36) was used in these experiments. The recommended seed rate (60 kg) and spacing (15 X 10 cm) of the study area were used for this rice crop.

RESULTS AND DISCUSSIONS

Yield Components of Rice: The yield components of rice were greatly influenced by post panicle initiation nutrient management (Table 2). Among the treatments, application of N and K at flowering with slag at PI stage (T_7) recorded the highest number of productive tillers, panicles m^{-2} during both the seasons, which were comparable with application of NPK at flowering stage and Si at PI stage (T_8). The same trend was followed in filled grains per panicle also. The post panicle initiation did not significantly influence the test weight of rice during both the seasons.

The favourable effect of slag with higher levels of nitrogen on panicle production as observed in the study might be due to increased productive tillers m^{-2} production. Higher nutrients availability because of slag application augmented the uptake of nutrients and higher foliar NPK concentration at booting to one week after flowering stages. This resulted in higher photosynthetic efficiency which might have increased the productive tillers[2,11].

The ability of spikelets to accept the carbohydrates, translocation of assimilates from leaves to spikelets and the source activity relative to sink size influenced the filled spikelets percentage[11]. Higher availability of N and better nutrition at panicle initiation and flowering stages might be responsible for increased number of filled spikelets. Increased levels of N with slag and K application, the plants remained green even in the later stages and hence the contribution of carbohydrates from current photosynthesis might be more and efficiently translocated in to the grain and thus increased the number of filled grains per panicle[6].

Increase in panicles per unit area and number of filled grains per panicle with increase in nitrogen level was also observed[3,8]. Integration of slag with N increased the number of panicles and number of filled grains per panicle, probably as a result of providing NPK supply throughout the crop growth. This is due to the fact that slag increased the P availability, which coincides with the N and K application at flowering stage[10]. Test weight, being genetically controlled, manipulation of this component agronomically is possible only to a limited extent. Favourable influence of N application with slag on test weight was observed by Ota[5].

Grain and Straw yield: Post panicle nutrient management substantially influenced the grain yield in both the seasons. In r*abi* season, application of slag at PI stage with N and K at flowering stage (T_7) increased the grain yield. The highest grain yield of 4889 kg ha^{-1} was recorded in this treatment, which was superior to all other treatments. However, application of NPK at flowering stage with slag at PI stage (T_8) did not increase the yield level drastically and was comparable with other treatments. The grain yield during k*harif* season was higher than that obtained during r*abi* season. During this season, the highest grain yield of 5760 kg was obtained in treatment (T_7). The higher grain yield of rice could be obtained when slag, N and K were applied at PI and flowering stage respectively.

During r*abi* season, the straw yield significantly varied with different level and split application of nutrient. All the other treatments registered significantly increased straw yield than control. The highest straw yield of 7632 kg ha^{-1} was recorded in N and K applied at flowering stage (T_6) and this was on par with other treatments except control.

During *kharif* season, the straw yield registered similar trend to that of grain yield. The highest straw yield of 7806 kg ha^{-1} was obtained in slag application along with N and K at flowering stage (T_7); this was comparable with treatments T_4, T_2, T_6 and T_8. The other treatments produced lower straw yields but significantly higher than control.

Irrespective of season and variety, the treatments expressed their effects clearly on grain yield. Increased yield due to integrated slag and N application has been reported[4,10]. The significant improvement in growth characters and yield components to higher N with slag ultimately resulted in higher grain yield. Most of the growth and yield components significantly responded to slag application at PI stage with N and K at flowering stage and their combined effect contributed to the increased grain yield with the highest N level.

Application of slag at PI with increased level of N with K at flowering stage resulted in highest yield with that of other slag applied plots. The yield increase was 14 percent during r*abi* and 42 per cent during k*harif* season than control. This might be attributed to the

Table 2: Yield components of rice as influenced by post panicle nutrient management

Treatments	*Rabi* – 2000 - 01				*Kharif* - 2001			
	No. of Productive tillers m^{-2}	Panicles m^{-2}	No. of filled grains $panicle^{-1}$	1000 grains weight (g)	No. of Productive tillers m^{-2}	Panicles m^{-2}	No. of filled grains $panicle^{-1}$	1000 grains weight (g)
T_1	374	392	79.7	20.2	419	397	81.7	21.1
T_2	462	435	83	20.7	498	442	86	20.7
T_3	455	385	82.7	20.6	472	393	87.3	20.8
T_4	495	419	94	21	527	437	97	20.5
T_5	440	397	93.3	20.3	459	452	94.3	20.3
T_6	462	440	82.3	21.2	507	484	88.4	20.5
T_7	568	482	112.6	21.6	596	586	122.6	21.8
T_8	527	436	106	21.3	573	449	112.5	21.6
SEm ±	23.6	13.3	7.5	0.22	29	11.1	5.1	0.17
CD (P-0.05)	71.4	40.2	22.6	0.67	87.7	71.4	15.3	0.5

Table 3: Grain, straw yield and harvest index as influenced by post panicle nutrient management in rice

Treatments	*Rabi* - 2000 - 01			*Kharif* - 2001		
	Yield (kg ha^{-1})		Harvest index	Yield (kg ha^{-1})		Harvest index
	Grain	Straw		Grain	Straw	
T_1	4277	5648	0.43	4039	5083	0.45
T_2	4375	7078	0.38	4428	7013	0.38
T_3	3958	5799	0.41	4786	6215	0.44
T_4	4154	6353	0.4	5177	7110	0.42
T_5	4297	5456	0.44	4451	5416	0.45
T_6	4056	7632	0.35	5086	7000	0.42
T_7	4889	7583	0.39	5760	7806	0.42
T_8	4385	7177	0.38	4990	6949	0.42
SEm ±	149.9	483.8	0.02	232.6	498.7	0.02
CD (P-0.05)	453.5	1463.5	NS	703.2	1508.2	NS

greater amount of silica in plant, which enables the tillers to be more erect, providing more exposure to sunlight and resulting in efficient assimilation of nutrients[9]. Higher levels of fertilizer nitrogen and steady contribution of N application at different stages especially at PI and flowering stage had favourable effect on plant height, tiller per unit area and dry matter production which ultimately resulted in higher straw yield[1]. Application of slag produced more straw yield in *Kharif* and it was less during *rabi* though there was a trend of increased straw yield due to slag application in *rabi*[4].

Harvest Index: Though application of P at flowering stage (T_5) recorded higher harvest index in both the seasons, it was comparable with all the other treatments. Increasing N beyond recommendation level did not influence the harvest index in both the seasons.

The ultimate partitioning of dry matter between grain yield and vegetative part is indicated by harvest index (HI). Increasing N levels beyond a limit did not increase the HI. Probably, there was not a drastic increase in grain yield in relation to increased biological yield [3]. No perceptible influence of furnace slag was observed in harvest index.

One thing is clear from the experiments that a controlled biomass production is the ultimate need to build positive grain yield, rather a vigorous, robust initial biomass production through N at flowering application, which lead to an unaltered harvest index.

Conclusion: From the two years of experimentation, it is concluded that application of furnace slag and increased level of N with K at flowering stage resulted in higher biological yield than all the other nutrient management practices. This nutrient management would improve the soil fertility by facilitating nutrient availability intern more nutrient uptake. Hence, this post panicle initiation nutrient management will be the suitable practice for western agro climatic zone of Tamil Nadu, India

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